Certain chemical constituents of plants considered in relation to their morphology and evolution.*

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The writer has been engaged for some time upon the study of plants by means of proximate qualitative and quantitative chemical analysis, in which the latest methods advanced by Dragendorff were followed. The facts obtained from these studies tend to show a chemical progression in plants, and a mutual dependence between chemical constituents and change of vegetable form.

All plants which were known to contain *saponin* were examined to determine the correlation between this constituent and the accompanying morphological forms. It was found that these saponin plants occupied the great middle plane of M. Edouard Heckel's scheme of plant evolution.[1] M. Heckel arranges all plants within three divisions: 1. Simplicity of floral elements; 2. Multiplicity of floral elements; 3. Condensation of floral elements, and in addition he bases his theories upon three characters: Filiation, adaptation, and progression. These laws as well as the three divisions of development, are not only elements of test for the great divisions, but are to be found in orders, sub-orders and classes. It is a significant fact that all the saponin groups belong to this middle division, or multiplicity of floral elements. Saponin is thus a constructive element in developing the plant from the multiplicity of floral elements to the cephalisation of those organs. It is an indispensable principle in the progression of certain lines of plants, passing from their lower to their higher stages. Saponin is invariably absent where the floral elements are simple; it is invariably absent where the floral elements are condensed to their greatest extent. Its position is plainly that of a factor in the great middle realm of plant life when the elements of the individual are striving to condense and thus increase their physiological action and the economy of parts. All the great groups which contain saponin are closely allied and possess other properties in common, as fibrous or bulbous roots, rootstocks, tubular character of some part of the flower, and a climbing tendency in *Smilaceæ* and some of the *Sapotaceæ*.

Numerous analogous examples of a correspondence between morphology and chemical constituents were advanced, and the following conclusions reached:

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* Abstract, by the author, of a paper read before the A. A. A. S., Buffalo meeting, 1886. Evolution used in the sense of progression.

[1] Les plantes et la théorie de l'evolution, *Revue Scientifique*, 13 Mars. 1886.

1. A similarity of one or more chemical constituents is to be found in all plants which are equally developed, and on the same evolutionary plane.

2. The evolution of chemical constituents in which they follow parallel lines with the evolutionary course of plant forms, the one being intimately connected with the other, and consequently that chemical constituents are indicative of the height of the scale of progression, and are essentially appropriate for a basis of botanical classification. In other words, that the theory of evolution in plant life is best illustrated by the chemical constituents of vegetable form.

The reasons offered in favor of a chemical basis of classification are:

1. The disagreement among botanists themselves, depending upon the insufficiency of the present methods of classification.

2. Chemical constituents, or the constructive elements of form are intimately associated with the origin and progression of plant life, and are consequently better adapted for classification than organs and tissues because as component parts less complex.

3. By the invariable composition and structure of given determinate chemical constituents.

4. The percentage of any given compound in a plant would gauge the progression or retrogression of a plant, species or genus, and would accentuate the characters of progression, adaption, and filiation.

5. Variations in chemical constituents would be detected by analysis earlier than consequent variations of organs or tissues.

6. It is a law of internal influences controlling function and modifying forms rather than of external forces, hence a study of the elements of the innermost structure of plant life is a study of that law and of life itself.

All chemical constituents will not answer as means of classification for the same great evolutionary plane, though any compound might be found to furnish a basis for the division of plants into classes, orders, sub-orders, genera and species.

Albuminous compounds and chlorophyll are less likely to be serviceable as compounds of classification. They are intimately associated with the manifestation and continuance of the conditions of life though they are not regarded as the essential factors in development.

The chemical study of plants is meant to include microchemistry in its application to histology and physiology, in determining the position in the cell of any chemical compound, and qualitative and quantitative analysis to be practiced in accordance

with the schemes of Dragendorff and others. I should suggest that analysis be made of each part of the plant, as of the root, stem, bark, wood, leaf, flower, and seeds; also of the separate organs of plants, *i. e.*, in the flower, of the stamens, pistils, petals, calyx, and of various plants under various conditions of age, climate, soil and seasons. Under these conditions a comparison of chemical constituents with plant structure would lead to a comprehension of the correlation between morphology and chemistry.

BRIEFER ARTICLES.

An interesting Peronospora.—The *Peronospora graminicola* Schr. is abundant here this season on Setaria viridis. Dr. Farlow gives a description of the species in the BOTANICAL GAZETTE, March, 1884, p. 39, after which he says: "This curious species, for which Schroeter has created the sub-genus *Sclerospora*, has been found in several European countries, but is at present only known at La Crosse (~~Minn.~~) in this country." The specimens gathered here are more vigorous, seemingly, than those from which the description of the species was made. For example, the conidiophores, instead of being solitary or sparingly branched, are clustered and much branched. But that which will most interest all lovers of the Peronosporæ is the fact that this mildew attacks the spikes of the Setaria and frequently distorts the floral parts beyond all recognition. Herewith is shown[1] a "head" of the foxtail flowers, drawn natural size. Instead of the apparently cylindrical spike, three or more inches long, with its many long bristles, there is a smooth head, or short spike of floral parts, as shown at *a* in the engraving. Rarely more than one head in the same plant is thus deformed. With few exceptions, the essential parts of the affected flowers are either abortive or wanting. At *b* is shown a spikelet double its natural size. The affected floral parts are usually of a purplish color, and abound in the oöspores of the Peronospora. In many of the palets and flowering glumes the thick-walled, dark brown or chestnut oöspores are so numerous as to occupy nearly all the space within the epidermis.

On other culms without flowers the upper leaves are frequently very stiff, upright and colored dark brown. In such the oöspores have formed in countless numbers.—BYRON D. HALSTED, *Agricultural College, Ames, Iowa.*

John Goldie, gardener and botanist.—John Goldie was born near Maybole, in the district of Carrick, Ayrshire, on the 21st March, 1793. Having selected gardening as an occupation, he was for a time under instructions in the art in the gardens of Kilkenam, a residence of the Fergusons, an Ayrshire county family, situated on the Girvan river in Carrick. At an early period of his career he became associated with Mr. James Smith, well known in his day

[1]See plate VIII.